Exotic Species

Project title: Gypsy Moth Trapping Program

Principal investigator: Mr. Paul Miller
Phone: 307-344-2185
Email: Paul_Miller@nps.gov
Address: P.O. Box 168
Yellowstone National Park, WY 82190

Objective: To trap Gypsy Moths *(lymantris dystrlinnaus)* with pheromone traps and eliminate that non-native species so they don't defoliate the trees of Yellowstone National Park.

Findings: We put out 105 pheromone traps throughout Yellowstone National Park where vehicles were left for one day or more during the spring, summer, and fall. The traps lure gypsy moths into them from a radius of one mile around the traps. We checked the traps throughout the summer and gathered them in the fall. Any Gypsy Moths are identified and destroyed and a grid of traps is set up in the near vicinity to trap any other Gypsy Moths in the area.

We set out 105 traps and the only major suspect was found in the Fishing Bridge RV Park with trap 7B.

Project title: Food Web Impacts of Exotic New Zealand Mudsnails in Rivers in Yellowstone National Park

Principal investigator: Dr. Robert Hall
Phone: 307-766-2877
Email: bhall@uwyo.edu
Address: Department of Zoology and Physiology
University of Wyoming
Laramie, WY 82071

Additional investigators: Mark Dybdahl, Billie Kerans

Objective: Our objective is to measure mud snail and native invertebrate secondary production in the Firehole and Gibbon Rivers as a means of estimating the degree to which mud snails dominate invertebrate production and energy flow through food webs.

Findings: We have completed one year of sampling of the Firehole and Gibbon Rivers as of September 2001. All data are collected, and we are analyzing it and preparing a manuscript. We found very high rates of snail secondary production and biomass, and these rates are higher than that for any taxa of native invertebrates, suggesting that mud snails are dominating the invertebrate assemblage. We also found fewer mud snails in summer 2001 in the Firehole River than in sum-

mer 2000. This decrease in mud snails appears to be correlated with an increase in native snail and invertebrate densities. For this reason we would like to collect summer invertebrate samples from these sites for several years to document population changes in snails and if they cause population changes in native invertebrates.

Project title: Linking Modeled and Experimentally Measured Interaction Strength Between Exotic New Zealand Mudsnails and Algae in Rivers

Principal investigator: Dr. Robert Hall
Phone: 307-766-2877
Email: bhall@uwyo.edu
Address: Department of Zoology and Physiology
University of Wyoming
Laramie, WY 82071

Additional investigators: Billie Kerans, Mark Dybdahl

Objective: The objective is to estimate the impacts of exotic New Zealand mudsnails on benthic river algae using small scale experiments. We are also attempting to predict the snail impact by estimating the consumption rate of algae by snails relative to the growth rate of algae.

Findings: Mud snails have strong per biomass effects on algae production. Densities of only 13,000 adults/m2 can reduce primary production of algae on rocks in half relative to snail-free controls. Consumption rates of snails were near that of primary production in these chambers, suggesting that most primary production was consumed by snails. Per biomass impact of snails on algae in the Firehole was four times higher than the Snake River, despite the fact that snails grew faster in the Snake River. We have also combined these data with similar experiments conducted in Polecat Creek in the JDR Parkway just south of Yellowstone. We found almost no impact of mud snails in Polecat Creek, despite using very high densities of snails in the experimental chambers, suggesting that algae there can compensate for high grazing rates by snails.

We have completed the field parts of this project and we are analyzing data and preparing a manuscript.

Project title: Preliminary Sampling of Exotic Weeds in The Northern Ranges of Yellowstone: to Define a Sampling Methodology Protocol

Principal investigator: Dr. Lisa Rew
Phone: 406-994-7966
Email: lrew@montana.edu
Address: Department of Land Resources and Environmental Science
334 Leon Johnson Hall
Montana State University
Bozeman, MT 59717

Additional investigator: Bruce Maxwell, Tad Weaver, Don Despain, Richard Aspinall

Objective: The overall objective of the six-month pilot project was to determine the most efficient and accurate approach for creating an inventory of the non-native plant species within the northern elk winter range of Yellowstone National Park. The area is too large to look for non-native species over the entirety so we focused on identifying sampling methods that provide the highest probability of locating even the rarest non-native plant species. This overall objective would be achieved through computer simulation (Objective 1a) and field sampling (Objective 1b).

Objective 1a. Evaluate the most efficient sampling method to record species occurring at low frequency within a heterogeneous environment. This would be achieved by computer simulations of hypothetical plant population distributions and combining them with a variety of sampling strategies.

Objective 1b. Use the chosen sampling methodology to inventory the occurrence of target weeds in the northern range. Nine non-native target species were selected. These species were believed to represent a range of different frequencies and possess a range of growth habits. Species included: cheatgrass *(Bromus tectorum)*, smooth brome *(Bromus inermus)*, timothy *(Phleum pratense)*, spotted knapweed *(Centaurea maculosa)*, Dalmatian toadflax *(Linaria dalmatica)*, houndstongue *(Cynoglossum officinale)*, yellow sweetclover *(Melilotus officinalis)*, Canada thistle *(Cirsium arvense),* and ox-eye daisy *(Chrysanthemum leucanthemum)*.

Findings: Computer simulations to evaluate the most efficient sampling method to record species occurring at low frequency within a heterogeneous environment were performed in ESRI ArcView GIS. This implemented several different sampling strategies including simple random sample, random walk, random transects, transects normal to specified linear features, stratified random sampling, and regular (grid) sampling. Surveying along transects was found to be the most efficient and effective methodology for sampling the target weeds. Transects allow data to be collected continuously and a large sample size to be generated. Additionally, surveying along transects allows changes in underlying environmental variables to be recorded. This is important for estimating the geographic distribution of the species from the sample data.

The fieldwork was performed at four sites in the northern range in 2001. Transect positions were randomly generated, starting on roads or trails and were 2,000 m long and 10 m wide. The locations of target weeds were recorded with GPS along with details of habitat type, topography, aspect, and disturbance. Forty-two transects were completed. Using the data collected we can calculate the proportion of the study area infested with each of the target species. When all sites were combined the percentage of the study area infested was above 0.2% for all species except ox-eye daisy and spotted knapweed. The per-

centage infestation for the 16 transects around Mammoth were relatively high: Dalmatian toadflax and timothy were present at levels of 1.4 and 1.9% respectively, the remaining species were present at densities above 0.4%, with the exception of ox-eye daisy and spotted knapweed. When considering only the other three sites (Blacktail Creek, Tower Junction, Lamar Valley) the percentage infestation of timothy was still relatively high (1.5%) but the values for all the other species were less than half those calculated for Mammoth.

The perception was that higher levels of weed infestations would be found closer to areas of human disturbance. These perceptions were borne out with respect to roads/trails. As distance from road/trails increased, the occurrence of target non-native weeds decreased. For all species combined 35% were observed within 100 m of roads/trails, after which there was a very marked decline. Fourteen percent of all observations were made within 100–200 m, 6.5% between 400 and 500 m, and only 9% between 1,100 m and 2,100 m.

The data suggests that the big sage/bluebunch wheat grass *(Artemisia tridentata/Agropyron spicatum)*, big sage/Idaho fescue *(Artemisia tridentata/Festuca idahoensis)* and to a lesser extent Douglas fir/pinegrass *(Pseudotsuga menziesii/Calamagrostis rubescens)* habitats had a higher proportion of the target species.

Dalmatian toadflax, houndstongue, and yellow sweetclover were more common on an easterly aspect. Cheatgrass was more common on the easterly and southerly aspects. Timothy, Canada thistle, and smooth brome were equally prevalent on all aspects. Too few data points were collected for ox-eye daisy and spotted knapweed to determine a pattern. All the species, except timothy, occurred more frequently on sites with no aspect, i.e. level areas, but it should be considered that this information is confounded with moisture and angle of slope factors, as level areas generally also indicated increased moisture availability.

In all cases data were weighted to allow for the unequal number of observations taken in each variable class. However, it was not ensured that transects increased monotonically from 0 to 2,000 m from roads/trails; this will be addressed in subsequent data collection. Two different forms of analysis were performed—principal component analysis, and an inductive modeling procedure based on Bayes theorem within Arcview.

Project title: Cross-Boundary Plant Invasions in Protected Areas: The Case of West Yellowstone Area

Principal investigator: Dr. Paul Alaback
Phone: 406-243-2913
Email: palaback@forestry.umt.edu
Address: School of Forestry
University of Montana
Missoula, MT 59812

Additional investigator: Anibal Pauchard

Objective: 1) Determine susceptibility of plant communities to invasion at the landscape scale in the interface between Gallatin National Forest and Yellowstone National Park. 2) Determine both forest edge effects on alien plant invasions and biodiversity patterns, contrasting natural and human disturbances. 3) Determine the invasive strategy of *Linaria vulgaris* Mill. at multiple spatial scales

in the study area and characterize its potential to invade areas in relation to disturbance types and regimes.

Findings: *Linaria vulgaris* Mill. is invading disturbed areas in Yellowstone NP and Gallatin NF over 2,000 m in elevation. We assessed and monitored *L. vulgaris* in the West Yellowstone area using a multi-scale method during the years 2000 and 2001. At the landscape scale, the species occurs over a broad range of sites, both natural and human disturbed, apparently coming from two historical sources. The large majority of patches are located in Gallatin NF. At the stand scale, patches tend to be distributed randomly or dispersed in heavily infested areas and aggregated in newly invaded areas. Radial patch growth rates are related to site characteristics such as soil disturbance and nutrient availability. Clonal patch scale analysis shows that ramet densities and effects on native plants are higher in the patch centers than the edges. Both mean ramet height and reproductive vs. vegetative ramet height ratio are higher in patches core. We conclude that *L. vulgaris* is a significant threat to native biodiversity in open and human or naturally disturbed environments in protected areas of the Rocky Mountains. During 2002, we will monitor the species in the existing plots and will complete the landscape assessment. We expect to have publishable results at the end of 2002.